Review of *TinkerPlots™*

TinkerPlots™ is a program developed and distributed by [*Key Curriculum Press*](). The folks at Key Curriculum have a well-deserved reputation for putting out outstanding and innovative software such as *Geometer's Sketchpad*™. *TinkerPlots*™ is no exception. The program's target audience is upper elementary and middle school students studying the fundamental concepts of data analysis and statistics.

This software is particularly well suited to inquiry learning. The flexibility and ease of use of the program lend themselves to students exploring and developing questions of their own about data sets. *TinkerPlots*™ includes a number of tools that provide scaffolding for student learning.

Two of the most useful tools are *reference lines* and *dividers*. Horizontal and vertical *reference lines* provide an easy way for students to examine data points with a precise reference to the *x*- or *y*-axis. This provides visual cues and is extremely helpful for students in making sense of the data and discussing it with precision. Diagonal *reference lines* allow students to highlight trends in a data set. Teachers building on student insights derived from the use of this tool can move seamlessly to the concept of regression and lines of best fit.

Understanding measures of central tendency are crucial to studying statistics and data analysis. The *dividers* tool in *TinkerPlots*™ provides a means for students to highlight *center clumps* of data informally. Used in conjunction with *reference lines* students develop the concept of median. In Figure 1 data on roller coaster speeds are plotted in *TinkerPlots*™. Informally eyeballing the data a student notices the speeds tend to clump in the range of 65 to 85. Using the divider tool s/he highlights the *data clump* as shown in Figure 2.
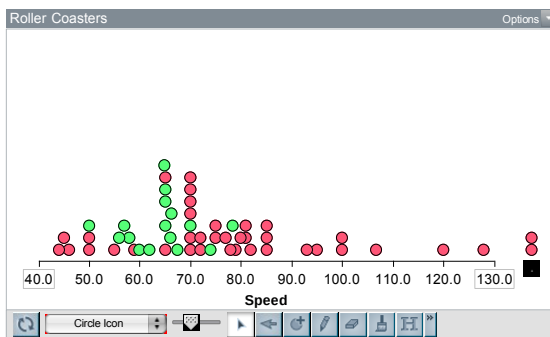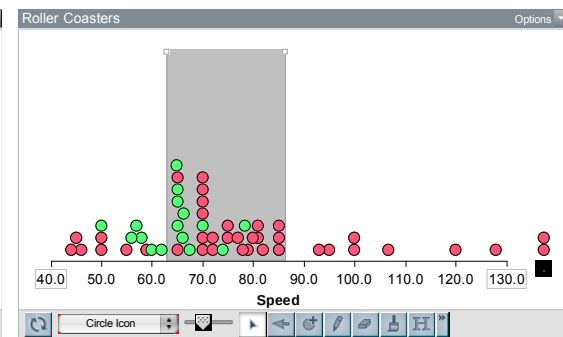

Figure 1

Figure 2

In Figure 3 the vertical *reference line* tool a student marks where the balance point might be if the data points were thought of as being on a balance scale. Note that *TinkerPlots*™ includes the numerical value 74.5 indicating the position of the line on the *x*-axis. Finally compare the informal eyeballing using the *dividers* and *reference lines* tools with the calculated percentile hat plot and median in Figure 4. It is from exploring data in ways such as this that students develop a deep understanding of how data analysis works and why it makes sense.
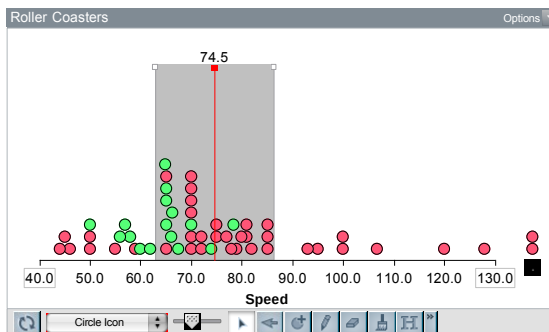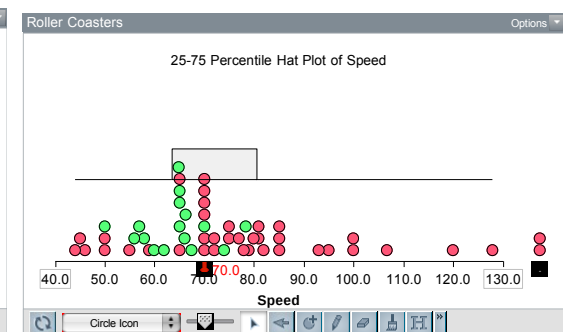

Figure 3

Figure 4

According to Cliff Konold, one of the developers of the program, students will opt to use the tools they understand rather than the more formal ones. This approach underlies the entire structure and interface of *TinkerPlots*™. This technique follows the concept-connecting-symbolic-abstract pedagogical model that is the basis of the *Math Their Way* program and the work of Kathy Richardson. In this model there are four levels of teaching and learning: concept, connecting, symbolic, and abstract. At the concept level students begin with something tangible such as manipulatives or a problem situation. The emphasis is on the students building conceptual knowledge by making sense of what they are doing and explaining their thinking. Only when their understanding of the concept solidifies does the teacher move to the connecting level by linking the concept level experiences with formal mathematical language and notation. At the symbolic level of instruction formal mathematical language and notation are used with reference to the manipulatives or problem context. The abstract level is the final goal of instruction. This level is attained when students are using standard mathematical language, notation, and procedures by generalizing their application in new situations.

TinkerPlots™ is based on an analogous paradigm. Students begin with graphical representations of data based on collections of easily understood cases. They are able to see many examples illustrating fundamental statistical concepts such as central tendency and variance to build the foundation for understanding. This corresponds to the concept level of teaching and learning. The connecting level is based on students' use of the informal tools built into the program. The teacher connects students' observations and insights with the formal terms and tools such as mean, median, and percentile hats. The result is the students using standard tools and mathematical language based on a real understanding of the concepts underlying them.

TinkerPlots™ is an amazing piece of software. It is highly recommended for any upper elementary or middle school teacher teaching data analysis and is particularly applicable to those using an inquiry-based approach. Teachers seeking to integrate mathematics into other curricular areas such as language arts, science, or social studies would also do well to add this to their teaching toolkit because it helps students use mathematics as a language to describe the world in those disciplines. Support in learning the program is provided in the form of a number of tutorial movies included in the program. *Key Curriculum Press* offers an on-line class and webinars as well.